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ABSTRACT

The structure and validity of Guglielmino's Self-Directed Learning Readiness Scale (SDLRS) have been examined repeatedly. In 1979, Mourad and Torrance investigated the construct validity of the SDLRS in a study involving a random sample of 684 of the 1,500 students enrolled in the University of Georgia's Program on Gifted/Talented Education. In 1990, West and Bentley examined the fit of the eight-factor measurement model underlying the SDLRS in a study involving 439 teachers and administrators from elementary, middle, and high schools across Tennessee who had participated in a professional development program. In 1994, Straka studied the feasibility of using the SDLRS in Germany by testing it on a sample of 442 students at Bremen University. The findings of the three studies were considered independently and together, and technical problems of measuring self-directed learning readiness were discussed. The following recommendations were made: (1) further analyses with different samples, especially from different cultures, should be conducted; (2) the structural models should be differentiated; and (3) theory-based models, especially models derived from cognition and metacognition, should be used instead of labeling factor solutions. (Contains 14 references.) (MN)

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Problems of Measuring Self-Directed Learning Readiness

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PROBLEMS OF MEASURING SELF-DIRECTED LEARNING READINESS[1]

Gerald A. Straka

"Few topics, if any, have received more attention in the field of adult education over the past two decades than self-directed learning", Ralph Brockett and Roger Hiemstra (1991, IX) are beginning their monography about perspectives on theory, research, and practice of self-direction in adult learning. Indeed, there is a long tradition of research and practice in this field in US-America. Indicators are the First Self-Directed Learning Symposium, held at Athens/GA, 1986 (Long and Associates, 1988) which will be followed 1996 by the 10th International Self-Directed Learning Symposium in West Palm. Self-direction in learning is also getting increasing attention in Germany (Prenzel, 1990, Straka, 1995), in Europe (First European Symposium-Colloque, Nantes, 1994, GRAF, 1995), and the Asia-Pacific Region (Asia-Pacific Seminar on Self-Directed Learning, Seoul, 1995).

Within the scientific discussion about self-direction in learning the empirical investigation of this phenomenon was a major focus, especially in the US. Concerning the quantitative approach, the Oddi Continuing Learning Inventory (OCLI, Oddi, 1984)) and the Self-Direceted Learning Readiness Scale (SDLRS, Guglielmino, 1977), are the two instruments who "have played a major role in making self-direction on of the most extensively researched areas in adult education during the decade of the 1980s" (Brockett & Hiemstra, 1991, 56).

For the SDLRS some of the author's information about its dissemination and quality of measurement are: "In 1977, Dr. Guglielmino developed, field-tested, and revised the Self-Directed Learning Readiness Scale. It has since been translated into French, Spanish, Japanese, Chinese, Finnish and Italian and used in over 150 research efforts, including more than 50 master's theses and doctoral dissertations. The SDLRS is cited in numerous articles and books relating to adult education and training and is generally recognized as the most valid and wideley-used instrument of its kind" (Guglielmino & Guglielmino, 1991, 272).

In Guglielminos's (1977) dissertation, in which the 'theoretical basis' for this instrument was established, the instrument consisted of 41 items. Principal component factor analyses with varimax rotation yielded 13-, 8-, 5- and 2-factor solutions, "but the eight-factor solution was chosen, since it provided the most meaningful and interpretable solution" (Guglielmino, 1977, 60). According to Guglilemino's interpretations these factors, with items loadings $\geq .30$ are:

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[1] This contribution is a partial result of the DFG-project STR 266/7-1.

[2] The SDLRS "is now available in four forms: general adult, elementry, business, and adult basis ... The general adult form is available in a self-scoring version" (flyer, dated 1991). However, it seems that the 58-items' form is most widely used. This information led to the idea to test this instrument under the conditions of the German culture.

(1) Openess to learning opportunities (8[3], 1, all reverse items)
(2) Self-concept as an effective learner (6, 3)
(3) Initiative and independence in learning (8, 1)
(4) Informed acceptance of responsability for one's own learning (6, 4)
(5) Love of learning (3, 3)
(6) Creativity (3, 4)
(7) Positive orientation to the future (3, 2)
(8) Ability to use basic study skills and problem-solving skills (2, 2).

For the 58-items form of the SDLRS there is no further publication of Guglielmino & Guglielmino themselves concerning the reconfirmation of the 1977 eight factor solution, which was based on the 'original' 41 items. However, they resume, that "examination of the literature reveals a large number of findings that provide evidence that the SDLRS does indeed measure the construct it was designed to measure. Overall, the validity studies show a definite positive relationship between SDLRS score and observable indicators4 of self-directed learning" (Guglielmino & Guglielmino, 1991, 27). However, the authors seem to pocess a larger sample indicated with the following formulation: "The latest reliability estimate of the SDLRS, based on a split-half Pearson product moment correlation with Spearman-Brown correction, is .91. The sample consisted of 3,151 individuals from a wide variety of settings throughout the United States and Canada" (Guglielmino & Guglielmino, 1991, 24).

Mourad & Torrance (1979), Field (1989) and West & Bently (1990) are the three studies which analysed explicitely the structure and validity of the SDLRS. However, Field did not published her factor solution with the items assigned to each factor5. Therefore the other two studies will be reviewed by focussing on their methods of revalidation:

MOURAD & TORRANCE (1979)

The purpose of their study "was to investigate the construct validity of the Self-Direceted Learning Readiness Scale" (Mourad & Torrance, 1979, 94). They refer to Guglielmino's (1977) and mention, that "subsequent to the try-out study [i.e. Guglielmino, 1977], 8 items were revised and 17 new items were added" (Mourad & Torrance, 1979, 94).

The sample of their study were 684 randomly selected students of the 1500 students who enrolled the University of Georgia Program on Gifted/Talented Education. The sample represented grades

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3 "Items which loaded on the factor under discussion but loaded more strongly on a different factor are listed in the table under a dividing line. These items were not considered in the naming of this factor, but were considered after the naming for possible confirmation ..." (Guglielmino 1977, 61). Therefore the number of the items used for interpretation are listed in brackets first followed by the number of items loading more strongly on a differnt factor.

4 Examples for these observable indicators are: number of learning projects conducted, hours spent in self-planned study, observer ratings of behaviours indicating self-directed learning.

5 Field's reply to the author's request for the data or her factor solutions with the assigned items was: "... unfortunately, I have not retained any of the data from my investigations" (FAX, 5/24/94)..

5 trough 12 from 12 different states. The intelligence quotient for 332 students was 133 with a standard deviation of 10.5.

Four criteria were considered for selection of the factor solution: (1) eigenvalue $\geq$ 1; (2) scree test; (3) the internal consistency of the factors expressed by Cronbach's alpha6 and factor loadings $\geq$ .3; (4) the interpretability of the factors, which is the most important criterion as the authors mention.

Five different solutions (4,5,6,7, and 8 factors) were estimated with the principal component model and varimax rotation. "The 8 component solution7 was preferred over the other solutions after applying all four criteria, mainly their interpretability and reliability" (Mourad & Torrance, 1979, 97). This solution, was interpretated and the eight factors labelled as follows (number of items assigned to each factor in brackets followed by the number of items loading higher on other factors):

(1) attitude toward and joy of learning [17,5];
(2) self-confidence in abilities and skills for learning [12,2];
(3) complexity, adventure, and independence in learning [17,4];
(4) attraction to new and unusual situations [10,3];
(5) openness to learning situations [8,4];
(6) internal control [5,1];
(7) self understanding [9,2];
(8) responsability for own learning [2,0].

Mourad & Torance (1979, 102) conclude that "the two sets of factors were not the same". They regard this result not as a deficit of the scale, because factor solutions may differ from sample to sample. However, they recommend that ".. more studies are needed to validate the scale using different samples" (Mourad & Torrance, 1979, 102).

WEST & BENTLEY (1990)

A purpose of this study "was to assess the fit of the eight factor measurement model underlying the SDLRS with [confirmatory factor analysis] procedures using the LISREL model and maximum likelihood estimation" (West & Bently, 1990, 161). 439 teachers and administrators from different elementary, middle and high schools across the state of Tennessee and who participated a professional development programm for schools, completed the SDLRS. "The factor loadings found in a previous study provided by Guglielmino (personal communication, January 8, 1989) were used to trim the full modell in the following way: 1) only those items that had previously loaded .40 or higher on a factor were retained and 2) only those items whose secondary loadings were less than .30 were retained. The application of these criteria resulted in

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6 It should be mentioned that the assumption for Cronbach's alpha is not compatible with the aim of the factor analysis. Cronbach's alpha assumes that each item has the same weight, whereas an aim of the factor analysis is to find out the importance of the items on the factors, which is expressed by the factor loadings; they are mostly different in realitiy.

7 The results will be found in Appendix I of this contribution.

the deletion of 25 items that loaded in an "ambiguous" fashion in the previous study8. In utilizing these restrictions, the intent was to work with a smaller set of items with good psychometric properties. Each of the 33 items that remained was thought to have a substantial loading on only one factor9 in the specified model". Their analyses led to the following general conclusions:

(1) "an orthogonal solution of the SDLRS measurement model is clearly inadequate. ... The factors are highly related" (West & Bently, 1990, 177);

(2) "the findings indicate that the six dimensions characterize the structures underlying responses to these 33 items, that these six factors are highly correlated and that they are subsumed by a more general single dimension which represents the second order SDLRS structure" (West & Bently, 1990, 178).

Additional studies were recommended to determine "if these same models hold up when using the entire 58 item scale or when studying groups with different characteristics" (West & Bently, 1990, 178).

STRAKA (1994)

Noticing that there was neither a German SDLRS form (Guglielmino & Guglielmino, 1991) nor an official use of this instrument in Germany till 1991 and that both studies summarized ahead are recommending further validation studies with different samples, and personally sharing the discussions about this instrument during the annual International Self-Directed Learning Symposia, the idea was born to test this - nearly worldwide used instrument - tentatively in the former Federal Republic of Germany.

For this purpose the 58-items form was independently translated in German by two persons. Differences in translations were checked and harmonized10.

442 persons filled out and returned the instrument. Most of them were students from the departments of teacher education (38%), others from law (9%), social work (4%), older adult (6%) and others of Bremen University. 37% were aged less than 25 years, 51% were female, and 53% had job experience.

The aim of comparing the results of this reanalysis of the SDLRS with those of the studies already reviewed some pre-decisions were necessary. Mourad & Torrance (1979) realized their principal component factor analysis and varimax rotation with all the 58 items, whereas West & Bentley's LISREL published factor analyses included only 33 items of the SDLRS. Considering that there might be possible confoundations between method of analysis, items and characteristics of the samples, the comparison of the results between Mourad & Torrance and Straka will be made first, followed by the same procedure with West & Bently and the reduced number of items.

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8 It should be pointed out that these remaining items (i.e. 58 minus 24 items) are identical with the Mourad & Torrance (1979) solution.

9 It should be indicated, that the criteria of single structure was not realized by Guglielmino (1977).

10 However, there was no retranslation from German to US-English by a native speaker. This should be realized by comparing these results with those of the other two studies.

MOURAD & TORRANCE - STRAKA

Mourad & Torrance's eight-factor solution explains 39%11 of the total variance compared with 42% of Straka's (see appendix I). 27 of the 58 items are loading on the same factors. However, there are some changes in the factors' composition. The two items (items 15, 50) loading on factor VIII of Mourad & Torrance are assigned to factor VI in Straka's solution, to which additional two items of Mourad & Torrance's factor V are associated (items 52, 56). The same situation was realized with factor VII of Mourad & Torrance, where most of the items with single structure quality are represented by Straka's factor VIII (items 16, 21). Factor III of Mourad & Torrance is divided by three items loading on the same factor (items 29, 48, 56) and six items loading on Straka's factor IV (items 6, 7, 9, 12, 19, 31) in both solutions. Considering this the commonness of these two factor solutions increases to 41 items or to nearly three quarters of the items (71%)12.

If the criteria single structure of the factor analysis is taken in account, the one-to-one correspondance of the factor solutions is reduced to eight items and additional ten items with loadings on the same but differently ranging factors. All together this are the following 18 or about one third (31%) of the 58 items (sorted according the solution of Mourad & Torrance):

Factor I

1. I'm looking forward to learning as long as I'm living
17. There are so many things I want to learn that I wish that there were more hours in a day.
45. I have a strong desire to learn new things.
46. The more I learn, the more exiting the world becomes.

Factor II

10. If I discover a need for information that I don't have, I know where to go to get it.
11. I can learn things on my own better than post people.
33. I don't have any problem with basic study skills.

Factor III

48. It's better to stick with the learning methods that we know will work instead of always trying new ones.

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11 It should be indicated that Mourad & Torrance did not specify the variance explained by each factor.
12 Nearly the same result was realized in a similar reanalysis with the OCLI (Straka, be published).

- loading on Straka's factor IV

6. It takes me a while to get started on new projects.
7. In a classroom, I expect the teacher to tell all class members exactly what to do at all times.
12. Even if I have a great idea, I can't seem to develop a plan for making it work.
19. Understanding what I read is a problem for me.

Factor IV (loading on Straka's factor VII)

34. I like to try new things, even if I'm not sure how they will turn out.
36. I'm good at thinking of unusual ways to do things.

Factor V (no correspondency with Straka)

Factor VI (no correspondency with Straka)

Factor VII (loading on Straka's factor VIII)

16. I can tell whether I'm learning something well or not.
21. I know when I need to learn more about something.

Factor VIII (loading on Straka's factor VI)

15. No one but me is truly responsible for what I learn.
50. I am responsible for my learning - no one else is.

(phrasing according to Guglielmino & Guglielmino 1991a)

Factor V and VI have no items in common. Therefore the constructs represented by them are no longer part in this cross-cultural comparison. However, they were also "weak" factors in the Mourad & Torrance's solution by having only one unique item both.

Two (16, 21) of the three items of factor VII in Mourad Torrance's solution are representing factor VIII in this solution. As item 14 ("difficult study doesn't bother me if I'm interested in something") the question might be raised if the interpretation "awareness of what is important and relevant, knowing own abilities and strengths, beeing self-motivated, autonomy, and beeing easily discouraged. It was labelled as self-understanding13" (Mourad & Torrance, 1979, 100) is still fully valid for these two remaining items?

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13 I seems that those items with no single structure were also part of Mourad & Torrance's (1979) interpretation.

Factor VIII of the former study is completely represented by factor VI in this study, i.e. according to Mourad & Torrance "it represents recognizing and accepting responsability for one's learning" (100).

One of the 12 items (= item 48) of the original factor III is again loading on the same factor. Four times more and different items (6,7,12,19) are loading exclusively on factor IV in this study. Guglielmino (1977, 64) labelled the former factor III with "initiative and independence in learning" and Mourad & Torrance (1979, 97) with "complexity, adventure, and independence in learning" (100). However, they additionally mention that "factor III is about the same as the first factor in Guglielmino's study (1977), where six of nine items which dominate her factor (openness to learning opportunities) have high loadings on the present factor [factor III, Straka]. Also this factor is close, partially, to the factor she called initiative and independence in learning." (Mourad & Torrance, 1979, 100) This aspect might be expressed with items 6,7 and 12. However, a question might be if having problems in understanding what one is reading is located on the same dimension of meaning compared with the three items just mentioned?

Three (10,11,33) of the eight items of factor II are common in both solutions. Mourad & Torrance argue that their interpretation "self-confidence in abilities and skills for learning" is "close to what Guglielmino (1977) called self-concept as an effective learner in terms of the items loaded on both factors." (Mourad & Torrance, 1979, 99) The basis for this interpretation might have been also the three items, each one with a different self-evaluation norm: a "social norm" by comparing onself with others (items 11), an "individual norm" by refering only to oneself (items 33) and the "criteria norm" by refering to the necessities of a perceived situation (Straka, 1983).

Four (1,17,45,46) of the eight items of Mourad & Torrance's factor I are loading on the same factor of this study. The authors label their factor "attitude toward and joy of learning" (Mourad & Torrance, 1979, 97) compared with Guglielmino's (1977, 62) "openness to learning opportunities". However, it should be noted that three of the eight items of Guglielmino's factor I in the 1977 41-items-form have the same phrasing in the 1991 58-items-instrument (i.e. items 23,31,32); three items have a different phrasing to a certain amount (22,29,35) and two items are no longer part of the 1991-form (14, 37 in 1977). Two of the three items of the 1977-instrument are loading on the same factor in the Mourad & Torrance's solution. However, they have no single structure (31,32). As a consequence, none of the original items is part of this comparative study, if only items with single structure are considered.

Mourad & Torrance's are labelling factor I with "attitude toward and joy of learning". This denomination seems to be close the meaning of the items assigned to factor I. However, there remains still the question if this label is representing the core meaning of self-direction in learning? Attitude toward learning is an undirected characteristic. Almost every learning occurs or non-occurs only if there is an or no attitude for this activity. Joy of learning is also not exclusively related to self-direction. Therefore an attitude toward and a joy of learning seems to be not sufficient to differentiate self-directed learning readiness from readiness for learning in general.

Before recording and discussing the results some information will be given about some general ideas about the LISREL-model. Jöreskog & Sörbom (1993) who developed LISREL (structural equation modeling with the SIMPLIS command language) distinguish three situtations in which their model may be used:

a) The **strictly confirmatory** situation where one single model is formulated and tested on empirical data, with the goal to accept or reject the model.

b) The **alternative models'** approach where several alternative or competing models are specified and tested on the same data, with the goal to select one of the models.

c) The **model generating** approach where a tentative initial model is tested. If the initial model does not fit the given data, the model is modified and tested again, using the same data with the goal "to find a model which not only fits the data well from a statistical point of view, but also has the property that every parameter of the model can be given a substantively meaningful interpretation. The re-specification of each model my be theory-driven or data-driven." (Jöreskog & Sörbom, 1993, 115)

West & Bentley start their analysis with a 'theoretical eight-factor model' based on "personal communication" (West & Bentley, 1990, 162)14. On the basis of the results of their analysis they modify the initial model into a six-factor, and after that to a three- and later on to a one-factor model, i.e. they shift from the confirmative to the model generating approach. Within the eight-, six- and three factor models they differntiate between the orthogonal and oblique solution. However, as they don't record which parameters are estimated for the oblique solutions according to the 'modification indices' generated by the programm, only the orthogonal solution for the eight-factor model15 will be presented, compared and discussed.

West & Bentley use four characteristics for testing the fit of their postulated models on their data: (1) the chi-square goodness-of-fit test (CHI-SQUARE), (2) the adjusted goodness-of-fit (AGFI), (3) the ratio of chi-square to degrees of freedom (X^2/DF), and (4) the root mean square residual (RMR). These criteria will be recorded next for the West & Bentley (W & B) (1990) eight-factor orthogonal model fit, and the same fits for the German sample by using West & Bentley's initial 'theoretical eight-factor-model' and Straka's 'theoretical model' (W & B-STR). The latter was derived from principal components factor analysis with varimax rotation (STR - STR) by retaining - like West & Bentley (1990, 162) only items loading .40 or higher on a factor and only those items whose secondary loading was less than .30.

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14 See also footnote 8.

15 Another reason for the limitation on the varimax solution was, that for Straka's solutions the factor intercorrelations are generally lower compared with those of West & Bentley.

The results are the following:

MODEL	CHI-SQUARE	DF	AGFI	X^2/DF	RMR
W & B	2671*	503	.60	5.31	.243
W&B - STR	1028*	467	.83	2.20	.063
STR - STR	706*	406	.88	1.74	.043

*: $p < .001$

The chi-square goodness-of-fit test was for all West-Bentley's models (West & Bentley, 1990, 165) significant on the $p < .001$-level and for the two Straka models too. These results indicate that all the models do not fit the data well, because the initial data (i.e. the initial covariance matrices) are not reconstructed by the results of any of the analyses (Jöreskog & Sörbom, 1993, 26 & 118).

Refering to recommendations in the methodological literature West & Bentley (1990, 164) indicate "that the chi-square/degree of freedom ratio of no more than 2 or 3 can be used to identify a good fit". The results verify the evaluation that each of the Straka solutions is a much better fit compared with West & Bentley16.

The magnitude of the Adjusted-Goodness-of-Fit-Index (AGFI), i.e. the proportion of explained variance by the model, can range between 0 and +1. The more the AGFI ranges toward +1 the better the fit of the model for the sample investigated. In the West & Bentley case the fit is .60 compared with .83 and .88 for Straka. This indicates a better fit for the latter models on the German sample.

The Root-Mean-Square-Residual (RMR)-index expresses the proportion of residual variance not explained by a model. Criteria for evaluation is the closeness to zero. It is obvious that compared with West & Bently Straka's results are far closer to this evaluation criteria, which - again - indicates a better fit in the German case.

SUMMARY AND CONCLUSIONS

The classical factor analyses (i.e. principal components & varimax rotation) of Mourad & Torrance (1979) and Straka explain nearly the same amount of variance (39% or 42%) and there is a commonness of nearly three quarters of the items (71%) assigned to the eight factors. However, if the criteria of single structure is applied the cross-cultural commonness is reduced to about one third of the items.

LISREL analyses indicate that for the eight-factor orthogonal model each of the two models tested with the German sample deliver a better fit compared with West & Bentley. However, the criteria used are testing only the global fit of the model. They give no information about the substrucutures within each model. For example the fit for the total model might be acceptable but

16 It should be noted that West & Bentley (1990, 165) realize fits between 2.15 and 2.58 only for their 8-, 6-, and 3-factor oblique solutions.

not for the substructure (Backhaus et al, 1994). Therefore a) further analyses with different samples especially from different cultures, b) differentiating structural models and c) theory-based models - especially derived from cognition and metacognition - instead of labelling factor solutions are recommended.

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gu58nss.xls: 8-Factor Solution - No Single Structure; MT: Mourad Torrance (1979) - Varimax, STV: Straka - Varimax;

It.	Factor I		Factor II		Factor III		Factor IV		Factor V		Factor VI		Factor VII		Factor VIII		cumunal.	
No.	MT	STV	MT	STV	MT	STV	MT	STV	MT	STV	MT	STV	MT	STV	MT	STV	MT	STV
1	59	42															43	29
2			32*	46									30*				27	36
3					43												27	23
4			31*	56									43*				40	39
5	69	64*		34*													58	57
6					31			35									26	30
7					43			48									22	31
8	36*	38											40*				38	30
9			37*		44*			36									38	34
10			46	46													28	32
11			65	35													51	32
12					31			47									30	39
13			36			56											23	40
14				45*		32*							38				40	41
15												67			75		61	55
16													50			64	32	50
17	58	64															41	46
18		32*		46*							42*		30*				48	40
19					41			61									30	42
20					36							52					34	38
21													52			63	36	50
22					33					-45							19	36
23		38			38												29	27
24	41	54*								36*							26	47
25			43*			54	32*										37	42
26	30*			39			35*										34	33
27			54	42*						37*							36	41
28	46	49*		32*													39	41
29					49	30*		48*									41	37
30		53*					53							31*			42	45
31	55*	46*			30*			36*									42	47
32	33*	47			38*												33	43
33			43	49													22	40
34							49							51			39	46
35					30*								32*			-34	38	32
36							63							66			49	56
37				35			44										28	32
38			64							41*				50*			54	53
39	34*	32*		52*			33*							32*			41	52
40				56							55						42	38
41				58			35*				36*						41	46
42			45							56	32*						42	41
43						60	39*		37*								41	42
44		34			40												35	26
45	61	68															50	58
46	59	74															54	62
47	72	72*		32*													64	64
48					44	-36											40	32
49	59*	63							34*								55	46
50												67			74		60	53
51	51*	48							35*								49	41
52						30*			50			30*					33	32
53	45*	55			35*												35	47
54	36*	38*							47*								43	46
55		34*					31*		30*					30*			41	36
56					32*	37*			54*			32*		34*			44	42
57			53	35*						55*							48	48
58									50*	63	40*						47	56
		17,5		5		4		4		3		3		3		2		
															39	42		

"*": items loading on more than one factor.

It. No.: Item number

MT: Mourad&Torrance (1979), principal components & varimax rotation

STV: Straka, principal components & varimax rotation

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